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EVALUATION OF THE FEASIBILITY OF EXTRACTING GOLD FROM FRASER RIVER DELTA DREDGED SAND USING A CANADIAN GOLD CENTRIFUGE

Final Report

by

Bacon, Donaldson & Associates Ltd.

March 1988

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Canmet Scientific Authority: T. Cienski

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May 12, 1988

DEPARTMENT OF ENERGY, MINES & RESOURCES
Canmet, Mineral Science Labs
555 Booth Street
Ottawa, Ontario
K1A 0G1

Attention: Mr. T. Cienski

Dear Mr. Cienski,

Re: DSS File No. 15SQ.23440-7-9168
Serial No. 23440-7-9168/01-SQ
BDA File No. 7595

Please find enclosed our report entitled "Evaluation of the Feasibility of Extracting Gold from Fraser River Delta dredged sand using a Canadian Gold Centrifuge". Due to major variations in the dredge operating schedules it was necessary to operate the centrifuge and associated equipment at three sites rather than at one site as originally proposed.

In order to adequately assess the metallurgical performance of the centrifuge it has also been necessary to include data developed in studies which are independent of the present program.

We trust that this report fulfills all the requirements of our contract. We would be pleased to answer any additional questions which you may have.

Yours truly,
BACON, DONALDSON & ASSOCIATES LTD.

M Beattie

Dr. M. J. V. Beattie, P.Eng.
MJVB:jrh

EVALUATION OF GOLD RECOVERY FROM FRASER RIVER SAND

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SECTION 1
EXECUTIVE SUMMARY

While the results of the present test program as well as those of unrelated tests on samples derived from hard rock ores have demonstrated that the Canadian Gold Centrifuge technology is capable of recovering fine particulate gold, the overall recovery achieved with this technology is very low. The nature of the gold lost to tailings was not established. It is possible that increased recovery can be achieved under idealized conditions of fine feed and constant flow. In the present study, the centrifugal concentrator was not effective for the treatment of a variable flow of sand having a wide size distribution and a low gold content.

The lower Fraser River delta sands have an insufficient gold concentration to justify treating it for the recovery of the contained gold even if the sand has already been excavated as part of normal dredging activity.

The gold in the Fraser River delta sands shows significant variations with regard to size and shape. While gold recovered at the Ladner test site is predominantly in the minus 200 mesh fraction and is angular in nature, the gold at the Barnston site is concentrated in the minus 65 mesh plus 200 mesh fraction and consists of rounded flakes.

SECTION 2
INTRODUCTION

It has long been known that fine particulate gold is present in the Fraser River Delta. The objective of the present programme is to evaluate whether this fine particulate gold can be recovered using technology developed by Canadian Gold Centrifuge Company (CGC). The presence of the gold in delta sands and the ability of this newly developed equipment to recover it has been established previously in a qualitative way. The present testwork represents a systematic evaluation of the concentration of gold in Fraser River Delta dredge sands which can be recovered using the centrifugal concentrator technology.

Canadian Gold Centrifuge Company (CGC) of Clearbrook, B.C. is a 100% Canadian owned company which has been developing equipment for the recovery of fine particulate gold from slurry streams. The technology consists of a method for applying very large centrifugal forces without having the contained solids "pack". Particles having the highest specific gravity (ie, gold) are retained inside the concentrator while lighter materials are ejected. The equipment has been applied successfully to recover gold from concentrator tailings following gravity concentration. A centrifugal concentrator is presently in operation at the Blackdome Mine in British Columbia.

2.1 Statement of Work

The present programme was developed to evaluate the application of Canadian Gold Centrifuge (CGC) technology as it may be applied to the recovery of fine particulate gold present in dredge sands. The programme was designed to achieve the following objectives:

1. Establish the applicability of CGC technology, including the mineral centrifuge and a means to remove a sized fraction from a dredge discharge line, to the recovery of gold from dredge sands. Both the technical and economic feasibility of the technology were to be considered.

2. Evaluate the recoverable gold content of Fraser River Delta sands.

3. Determine the behaviour of gold as it travels along a dredge discharge pipe.

4. Establish the character of the gold recovered as to its size distribution and physical shape.

To achieve these objectives the following sequence of activities was followed:

1. A land based test rig containing a CGC centrifugal concentrator was prepared by Dillingham Construction.

2. The prepared rig was installed in the discharge pipeline at a dredge site near Ladner. While it was originally intended to operate at only one site, due to the termination of dredging activity at this site it became necessary to relocate the rig twice; once to a site at Barnston Island and once to a site at Tillicum.

3. At each site the concentrator was operated as permitted by dredging activities and samples of concentrates and tailings were collected.

4. Samples from each site were transported to the laboratories of Bacon, Donaldson & Associates for analysis.

SECTION 3
RESULTS AND DISCUSSION

3.1 Description of CGC Technology

The centrifuge technology for recovering fine particulate gold from sands consists of a method for applying very large centrifugal forces without having the contained solids "pack". The application of these forces stratifies the material in the concentrator bowl according to differences in specific gravity. Particles having the highest specific gravity such as gold are retained inside the concentrator bowl while the lighter materials are rejected. The equipment constructed to date allows forces in excess of 300 G's to be applied. Patents have been applied for on this novel technology.

The prototype equipment which was originally developed and tested was of a batch nature. Slurry was fed through the concentrator until the concentrator bowl was sufficiently full to warrant a shutdown for clean-out. Extremely high gold concentrations (9000 oz/ton) have been achieved in the concentrator so that, depending on the gold content of the feed, operation could be continued for up to 10 hours between clean-ups. The time required for shutdown and clean-out is less than 2 minutes. Two prototypes have been constructed and operated in excess of 3500 hours without any mechanical problems. A batch type unit has been processing Deister table tailings at Blackdome since September, 1986. The machines are simple to operate and maintain. The equipment can be scaled up to handle hundreds of tonnes of material per hour. For the dredging programme a batch unit was utilized.

The development of a continuous discharge prototype was commenced in August 1986. A functional continuous machine has been built and was tested at the Blackdome Mine in British Columbia. A second generation continuous discharge unit is being constructed under a B.C. Science Council grant.

3.2 Methodology

For the dredging test programme CGC and Dillingham installed a modified section of pipe into the suction dredge discharge line. The modified section of levee pipe is shown in figure 3.1 together with a sketch showing the major components of the section. A screen provided by CGC permitted the removal of the desired size fraction of solids from the bottom of dredge discharge line. The slurry sample flowed under pressure to the centrifugal concentrator. The tailing from the concentrator overflowed into a Sala pump which returned it to the pipeline. The concentrator and Sala pump (figure 3.2) were contained in an 8' x 20' container shown in figure 3.3 together with a second container which housed a diesel generator and fuel tank.

Figures 3.4 and 3.5 show additional views of the sampling and discharge connections to the pipeline.

For each test run the concentrate was collected continuously within the concentrator. Tailings samples were taken with a sample cutter at the centrifuge discharge every 30 minutes for the short test runs and every 60 minutes for the longer tests. The solids concentration in the slurry fed to the centrifuge and the total throughput were determined on a regular basis to permit the calculation of average operating conditions. Although these average conditions were

calculated and are included in the present report, for the purpose of analyzing the results it should be noted that the operating conditions were in fact highly variable. Due to the nature of the dredging operation the slurry density varies widely over a short interval as the cutter head moves about. During the test runs there were also numerous periods when no slurry was flowing through the pipeline. These periods were recorded so that the actual time of slurry flow through the concentrator could be established.

At the end of each test run the concentrate was drained from the centrifuge for analysis.

FIGURE 3.1 View of modified pipeline show connections as identified in sketch below.

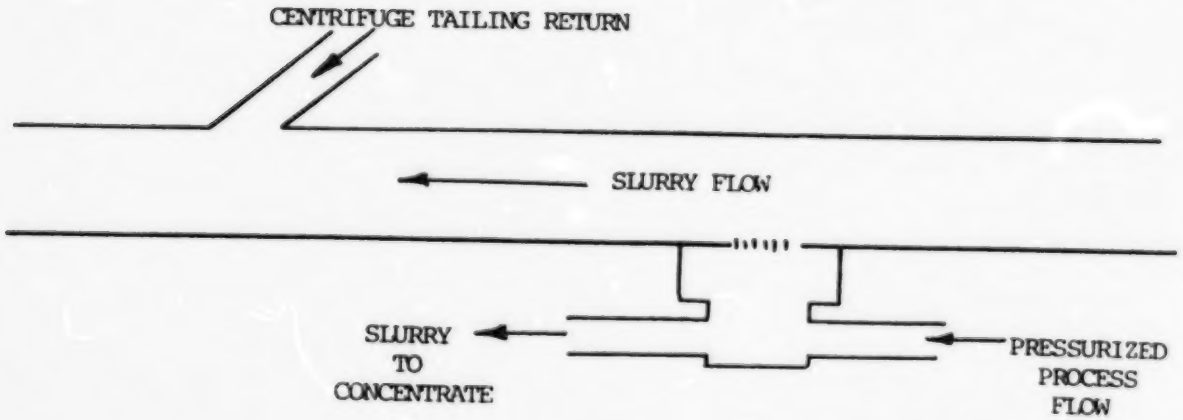


FIGURE 3.2 View inside test container showing centrifuge. Sala pump for return of slurry to pipeline is behind centrifuge unit.

FIGURE 3.3 View of containerized test rig at the Ladner site. The left container holds the test equipment while the right container holds the power plant. The modified section of the pipeline runs between the two containers.

FIGURE 3.4 Close-up view of pipeline connections showing water inlet at right and slurry discharge at left.

FIGURE 3.5 Container holding test equipment at pipeline section.

3.3 Test Results

The dredge programme was conducted at three locations on the lower Fraser River in British Columbia. It was originally intended to carry out the entire programme at one location so that the composition of the feed to the centrifuge would be constant. The dredge operation at the first two sites was terminated after relatively short periods so a total of three sites were tested in order to develop sufficient data for this study.

The first site tested was designated as the Ladner site. This area was located at the western limit of Ladner in the municipality of Delta, B.C. The second site was at the upstream end of Barnston Island, approximately 40 kilometers upstream from the Ladner site. The third site, designated the Tillicum site, was located between the other two sites on the North Arm of the Fraser River, at the foot of Tillicum street. At each location a series of test runs was carried out. While it was considered to be desirable to include some tests which were of several days duration it was found that the dredge did not operate in a way that permitted this. In general, after operating for a few hours the dredge would shut down for an extended period to relocate or to change the levee pipe configuration. Most of the test runs were therefore of a limited duration. The tests which were performed at each site are summarized in Tables 3.1 through 3.3. Concentrates and tailings samples from the tests were assayed for gold content. In addition, size assays were performed on a number of the samples to determine the size distribution of gold in the centrifuge

Table 3.1

Summary of Tests Conducted at Ladner Site

Test No.	Oper Time hrs	Avg % solids	Slurry Rate TPH	Solids Rate TPH	Conc Weight g	Conc Assay oz/ton Au	Total Au mg	Rate of Recovery mg/hr	Tail Assay oz/ton Au
1A	2.00	12.7	94.7	12.0	6770	.148	34.36	17.18	.005
2A	2.40	11.9	93.6	11.1	4368	.147	22.02	9.17	.002
3A	3.42	18.1	97.9	17.7	5838	.198	39.63	11.59	.001
4A	1.67	18.5	81.8	15.1	3800	.185	24.10	14.43	.001
5A	7.50	13.6	72.2	9.8	27360	.118	110.69	14.76	.004

Table 3.2

Summary of Tests Conducted at Barnston Site

Test No.	Oper Time hrs	Avg % solids	Slurry Rate TPH	Solids Rate TPH	Conc Weight g	Conc Assay oz/ton Au	Total Au mg	Rate of Recovery mg/hr	Tail Assay oz/ton Au
1	3.5	19	95.0	18.0	27259	.133	124.3	35.5	.002
2	4.0	21	82.2	17.3	11985	.139	57.1	14.3	.001
3	3.0	18	64.4	11.6	12142	.162	67.4	22.5	.003
4	----------abandoned----------								
5	0.5	18	91.1	16.4	8328	.064	18.3	36.5	.002
6	1.0	19	104.9	19.9	35190	.034	41.0	41.0	.002
7	1.0	26	145.5	37.8	1719	.384	22.6	22.6	<.001
8	1.5	25	133.8	33.4	1117	.394	15.1	10.1	<.001
9	1.5	24	94.8	22.7	3096	.092	9.8	6.5	<.001

Tests No. 1 through 7 sampled the bottom of the dredge discharge pipe while No. 8 and 9 sampled the side of the pipe.

Table 3.3

Summary of Tests Conducted at Tillicum Site

Test No.	Oper Time hrs	Avg % solids	Slurry Rate TPH	Solids Rate TPH	Concentrate Total g	Concentrate -12 mesh g	-12 Assay oz/ton Au	Total Au mg	Rate of Recovery mg/hr	Tail Assay oz/ton Au
1	3.33	7.0	79.6	5.6	7651	5928	.096	17.4	5.2	.002
2	6.58	7.0	72.0	5.0	20365	15363	.049	25.8	3.9	.002
3	8.25	7.0	76.4	5.3	19703	14000	.099	47.5	5.8	.001
4	11.67	7.6	90.7	6.9	10842	8015	.437	120.1	10.3	

concentrates and tailings. The detailed results for assays of the size fractions are included in Appendix I and II. The concentrate assays included in Tables 3.2 through 3.3 are the values derived from the size-assays since these were considered to be the most reliable.

3.3.1 Effect of Operating Parameters on Gold Recovery

The centrifuge itself does not have any adjustments which can be made during operation. The physical dimensions are fixed while the speed of rotation can be changed by changing sheaves. The operating variables are therefore the characteristics of the slurry entering the concentrator (ie, % solids, size distribution of solids, etc.) and the slurry throughput.

The results in Tables 3.1 through 3.3 do not show any relationship between the variables listed and the rate of gold accumulation. This is not surprising considering the variation in operating conditions encountered within the "average" values shown in the tables. The lack of variation in the results indicates that the performance of the concentrator is insensitive to the operating conditions across the range of values tested. It should be apparent that if the nature of the feed changed drastically, such as the percent solids increasing to 50% for example, the performance could be expected to be seriously affected. At a given set of conditions, increasing feed density would be expected to result in an increasing amount of concentrate being accumulated in the centrifuge.

One observation which was made and which is not apparent from the results is that when the size of the feed exceeds a certain critical size, an increased quantity of concentrate is produced. It has been postulated that this condition is reached when the particle size exceeds the thickness of the water film flowing through the concentrator.

3.3.2 Gold Distribution Within Dredge Discharge Pipe

Although the slurry travels through the dredge discharge pipe with sufficient velocity to move any rocks or debris which is encountered, it was expected that some concentration of gold could occur towards the bottom of the pipe. To test whether this concentration was occurring, tests were performed by removing slurry from the bottom of the pipe and from a point ~15° up from the bottom. Tests 1 through 7 at the Barnston site involved a bottom take-off point while tests 8 and 9 involved the side take-off point.

The results presented in Table 3.2 indicate that for the bottom samples the average rate of gold accumulation was 28.7 mg per hour while for the side samples it was 8.3 mg per hour. These results confirm that the gold becomes concentrated towards the bottom of the pipe as the slurry flows from the dredge towards the discharge point. It should be noted that the dredge is not operated to optimize gold recovery but rather to move an unclassified

sand and gravel product. By designing a system specifically for gold recovery the concentrating effect within the pipe could likely be enhanced.

All the tests conducted at the Ladner and the Tillicum sites were done with the bottom take-off position. It was estimated that the slurry withdrawn at this point represented 5% to 10% of the total slurry flow through the dredge discharge line.

3.3.3 Metallurgical Performance of Centrifugal Concentrator

The two figures used to evaluate the performance of concentrating devices are the grade of concentrate produced and the recovery which is achieved. Consideration of the data produced in the present study would indicate that the recovery of gold was insignificant. The tailings assays of the various test runs vary from less than 0.001 oz/ton to 0.005 oz/ton. The quantity of gold recovered in any of the test runs is insufficient to affect the assay of the material treated.

Size assays of tailings samples from the Ladner site are included as Appendix II. Although, in most cases, there is not a large variation in the assay of the various size fractions the results for the test runs are consistent in showing an increased gold concentration in the minus 200 mesh fraction. This fraction contains from 5 to 15 times the gold concentration of the overall tailings sample. As is discussed in Section 3.3.5, the gold recovered in the

concentrate at this site was also concentrated in this size range. Considering the large weight difference between the tailings and the concentrate it becomes apparent that the gold recovery was very low. Using the concentrate and tailing data for Run #2A at the Ladner site indicates that of a total of 315 mg of gold available, only 21.6 mg in the minus 200 mesh were recovered. The calculated recovery in this fraction is therefore 6.8%.

The grades of the concentrates produced in this study do not reflect accurately the concentrating capabilities of the centrifuge. The centrifuge accumulates gold over a period of time as slurry passes through. A concentrate produced over a short time interval therefore is expected to have a lower gold content than a concentrate produced over a much longer period. In the present program the duration of the test runs were too short to produce high grade concentrates. The results do indicate, however, that for test runs up to 12 hours in duration the rate of gold accumulation (mg/hr) does not decrease with time. The results in Table 3.3 for instance indicate the highest rate of gold accumulation for the test having the longest duration.

The results of the size-assays included as Appendix I indicate that the gold is concentrated in certain size fractions and that by screening off the coarser material, a final concentrate containing greater than 2 oz/ton gold can be produced even from the products of the present short test runs.

To assess the performance of the concentrator more fully it is useful to evaluate the results of testwork conducted independently of the dredge study.

A. A 14 kilogram sample of table tailings from the Blackdome Mine in British Columbia was ground to 80% passing 325 mesh and was then passed through a 5 inch laboratory model Canadian Gold Centrifuge. The results for this test were as follows:

Product	Weight %	Au oz/ton	Au % distribution
Concentrate	3.55	114.7	91.6
Tailing	96.55	0.366	8.4
Feed		4.196	

The results indicate a 28 to 1 ratio of concentration with a gold recovery of 91.6%. The results do not indicate whether the treatment of a larger quantity of material would result in additional upgrading of the concentrate while maintaining recovery. It is interesting to note that a centrifuge has been operating at the Blackdome Mine for the treatment of table tails for more than one year. Several kilograms of concentrate are produced every day, containing from 100 to 9000 oz/ton Au. At times the centrifuge concentrate contains as much as 20 ounces of

gold. There are no data available to indicate what the gold recovery from the table tails is while producing these concentrates.

B. A 15 kilogram sample of oxide ore from the Pine Tree deposit in California was ground to 62% minus 200 mesh prior to being treated with the centrifuge. Cyanidation of this material gives a gold extraction greater than 90%. The results of the centrifuge test are as follows:

Product	Weight %	Au oz/ton	Au % distribution
Concentrate	2.37	1.11	39.1
Tailing	97.63	0.042	60.9
Feed		0.067	

While gold has been concentrated into the concentrate, the recovery is very poor. The reason for the poor recovery was not determined.

C. A 93 kilogram sample of table tailings from the Energex deposit in northern B.C. was treated by passing it through the centrifuge. The results obtained are as follows:

Product	Weight %	Au oz/ton	Au % distribution
Concentrate	20.3	69.8	56.6
Tailing	79.7	13.6	43.4
Feed		24.9	

The reason for the large concentrate weight was that the feed sample contained a high proportion of barite. In spite of this excessive production of concentrate the gold recovery was very poor. It seems that when the feed material contains minerals with a high specific gravity, these minerals fill the collecting zone of the concentrator and prevent the further accumulation of gold. Similar effects have been noted when treating samples with a high sulphide mineral content. The optimum feed for the concentrator appears to be a very fine material (ie, finer than 325 mesh) having a low concentration of high specific gravity minerals. The slurry density and total flow through the concentrator also appear to have an effect on performance.

3.3.4 Economic Evaluation

One objective of the present study was to determine whether the concentrations of gold present in the sands of the lower Fraser River were economically significant. The maximum rate of gold recovery achieved in any of the test runs was 41 mg Au per hour which at a gold price of $450 per

ounce has a value of 60 cents per hour. This accumulation of gold is clearly not economic. Since the data in the present study also indicates that the gold recovery may have been less than 10% it may be possible that with suitable development of technology, up to nine times the present rate of gold recovery could be achieved. Furthermore, while only 1% of the total slurry flow was treated in the present program it is conceivable that up to 25% of the flow in the discharge line could be removed for treatment. As discussed in Section 3.3.2 the gold concentration in the sand decreases away from bottom of the pipe. Increasing the slurry flow from 1% to 25% of the total flow in the pipe therefore does not result in 25 times as much gold being available for recovery. Using an average value of the values presented in Section 3.3.2 indicates that by increasing the slurry flow 25 times the total gold available could increase by 16 times.

Taking both recovery and flow into account indicates that 144 times the rate of gold accumulation or 0.19 oz/hour could be foreseen. Using the same gold price as used previously gives a value of $85.50 per hour under these conditions. Considering the fact that 500 tons per hour would have to be treated and that the concentrate would have to be handled further indicates that the gold in the lower Fraser River sands is not present in economically significant concentrations at the existing price for gold.

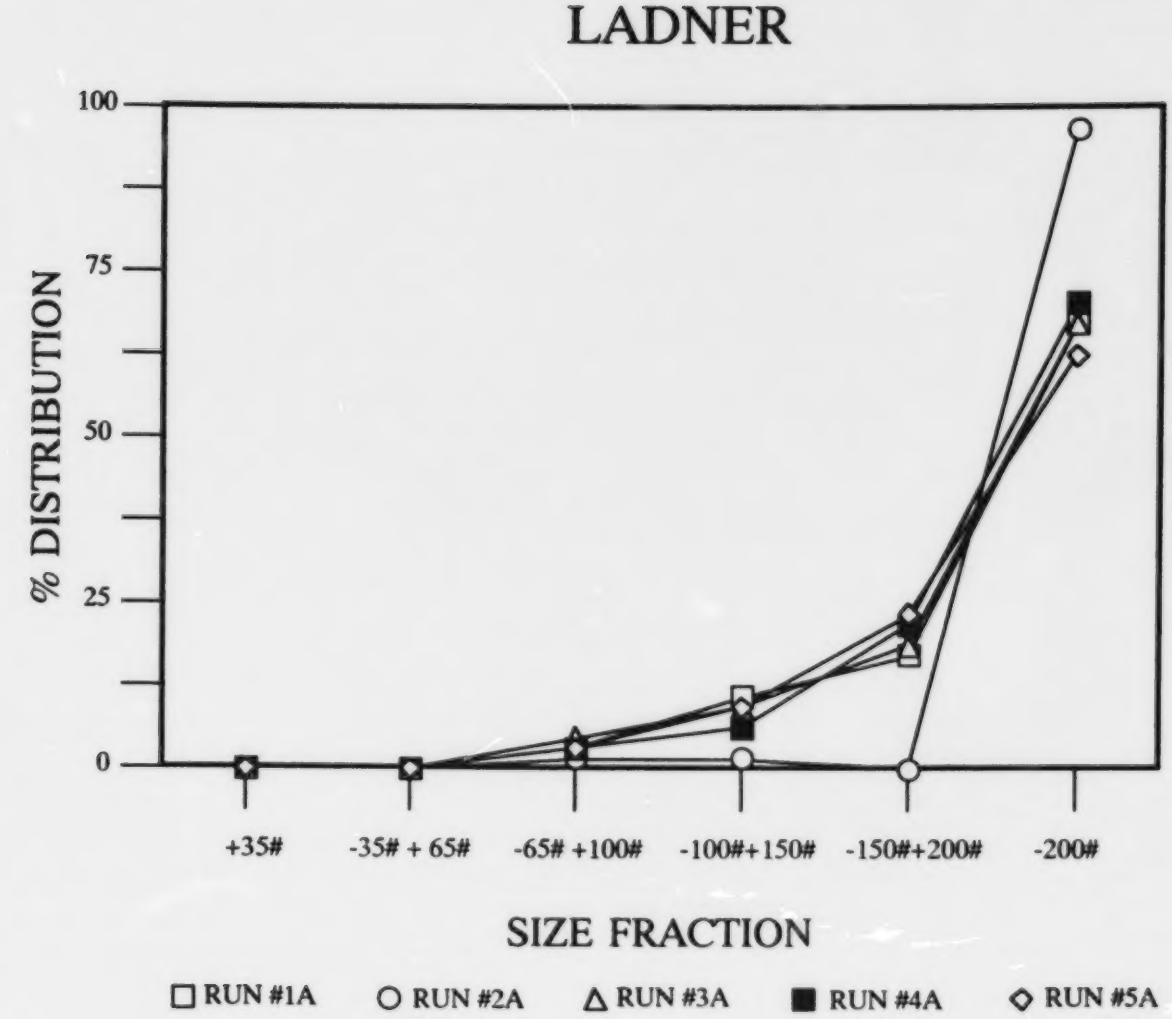
3.3.5 Characterization of Gold in Fraser River Sands

Concentrates collected at each of the three test sites were screened into a series of size fractions and each fraction was assayed for gold. The results for these analyses are tabulated in Appendix I, together with the calculated distribution of gold by size fraction. The results are presented graphically as figures 3.6 through 3.9.

Figure 3.6 shows the size distribution of gold recovered at the Ladner site. It is apparent that the gold at this site tends to be concentrated in the finer size fractions, particularly the minus 200 mesh fractions. While the total concentrate assayed less than 0.2 oz/ton Au the minus 200 mesh fraction generally assayed greater than 1 oz/ton and in run No. 2 contained 2.4 oz/ton Au.

By contrast, the size distribution for gold recovered at the Barnston site shows it to be concentrated between 100 mesh and 200 mesh with a lesser amount present in the minus 200 mesh fraction. The distributions for the gold recovered at the Barnston site are presented in figures 3.7 and 3.8. At both sites, from 50% to 90% of the concentrate weight could be removed without a significant loss of gold by screening off the plus 65 mesh material.

At the Tillicum site, figure 3.9, the gold is distributed throughout the size fractions below 35 mesh. From 40% to 60% of the concentrate weight could be discarded with a gold loss of less than 1% by screening off the plus 35 mesh material.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75
50
25
0
% DISTRIBUTION
+35#
-35# + 65#
-65# +100#
-100#+150#
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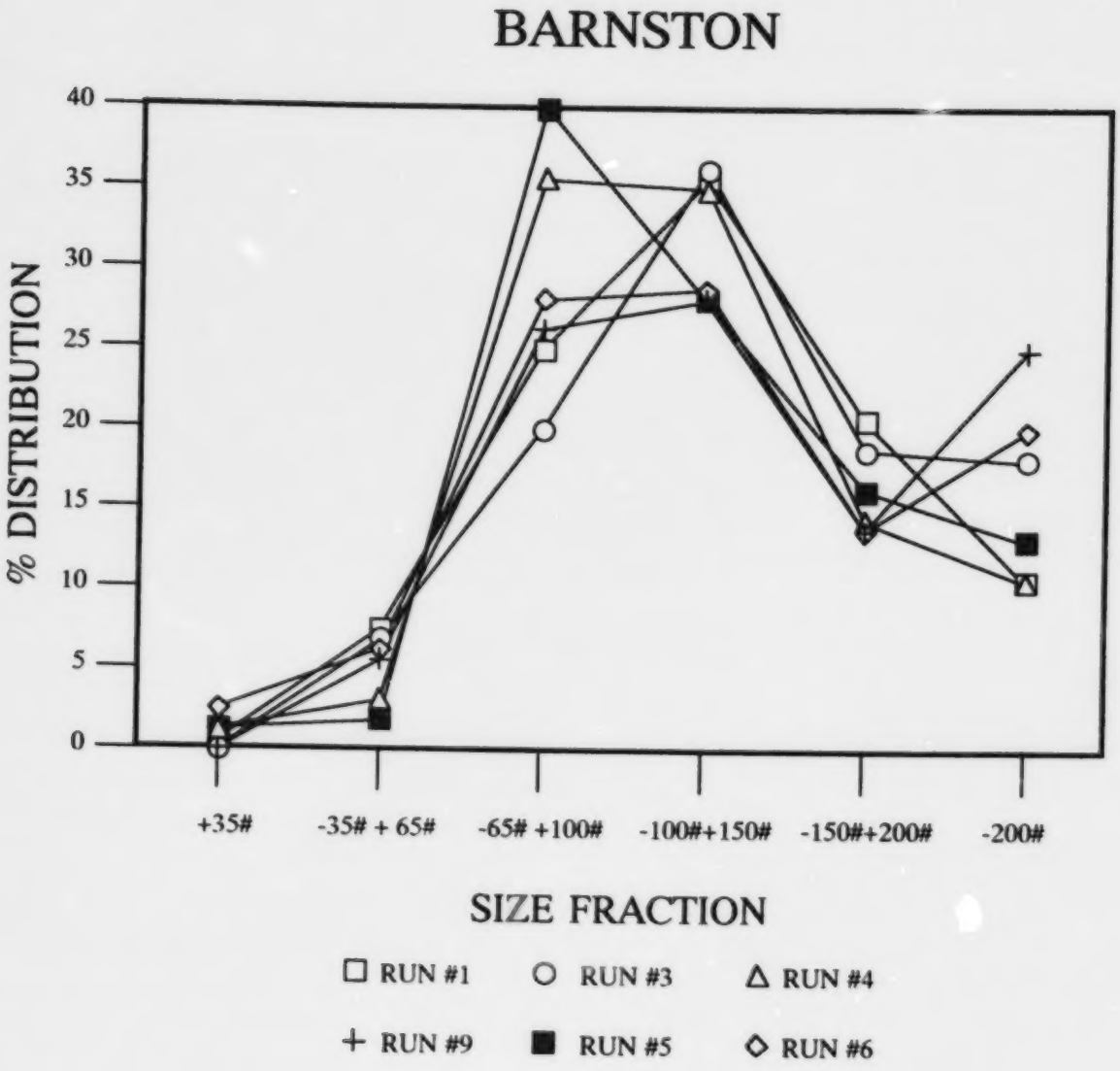
SIZE FRACTION
RUN #1A
RUN #2A
RUN #3A
RUN #4A
RUN #5A

FIGURE 3.6


BARNSTON
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30
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-100#+150#
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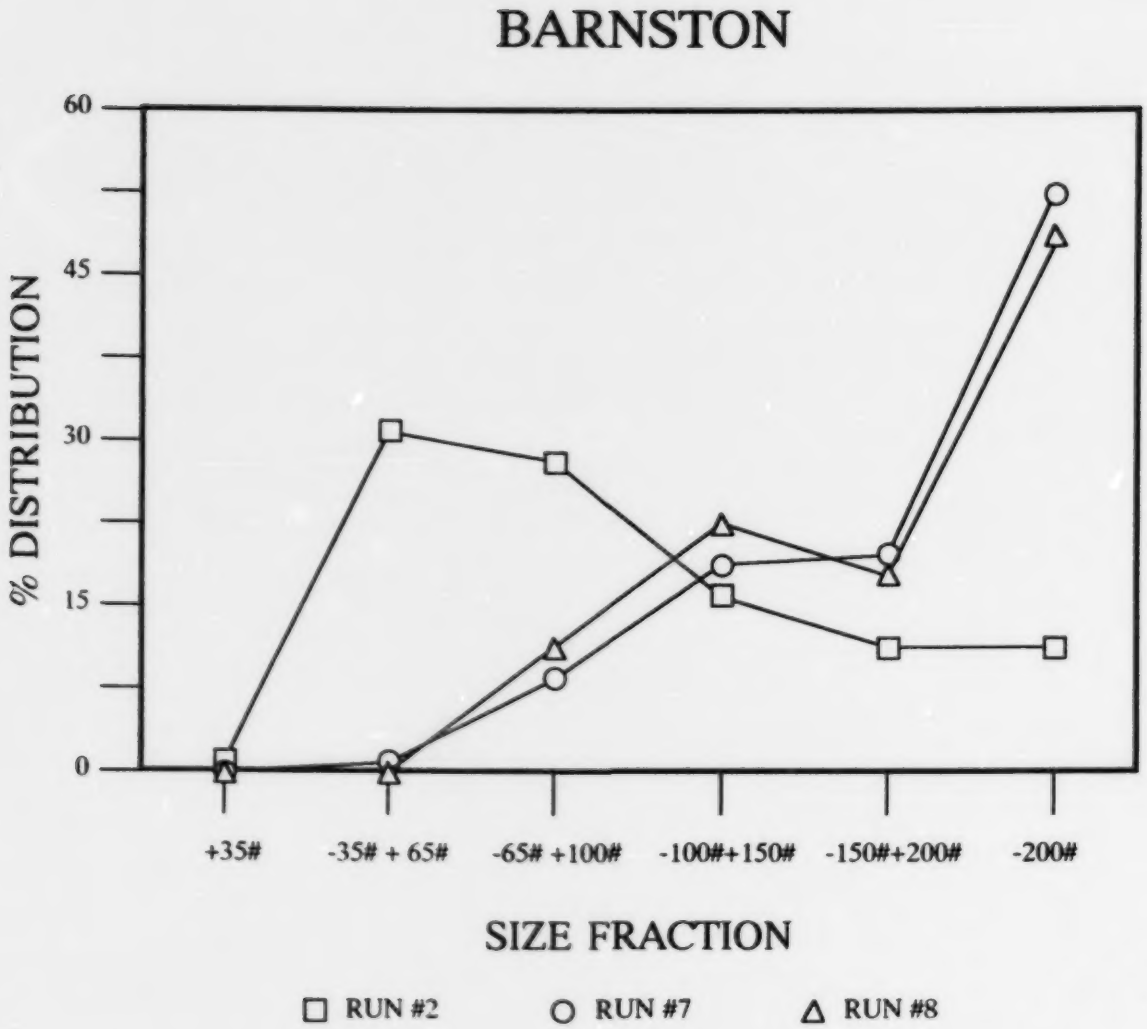
SIZE FRACTION
RUN #1
RUN #3
RUN #4
RUN #9
RUN #5
RUN #6

FIGURE 3.7


BARNSTON
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-35# + 65#
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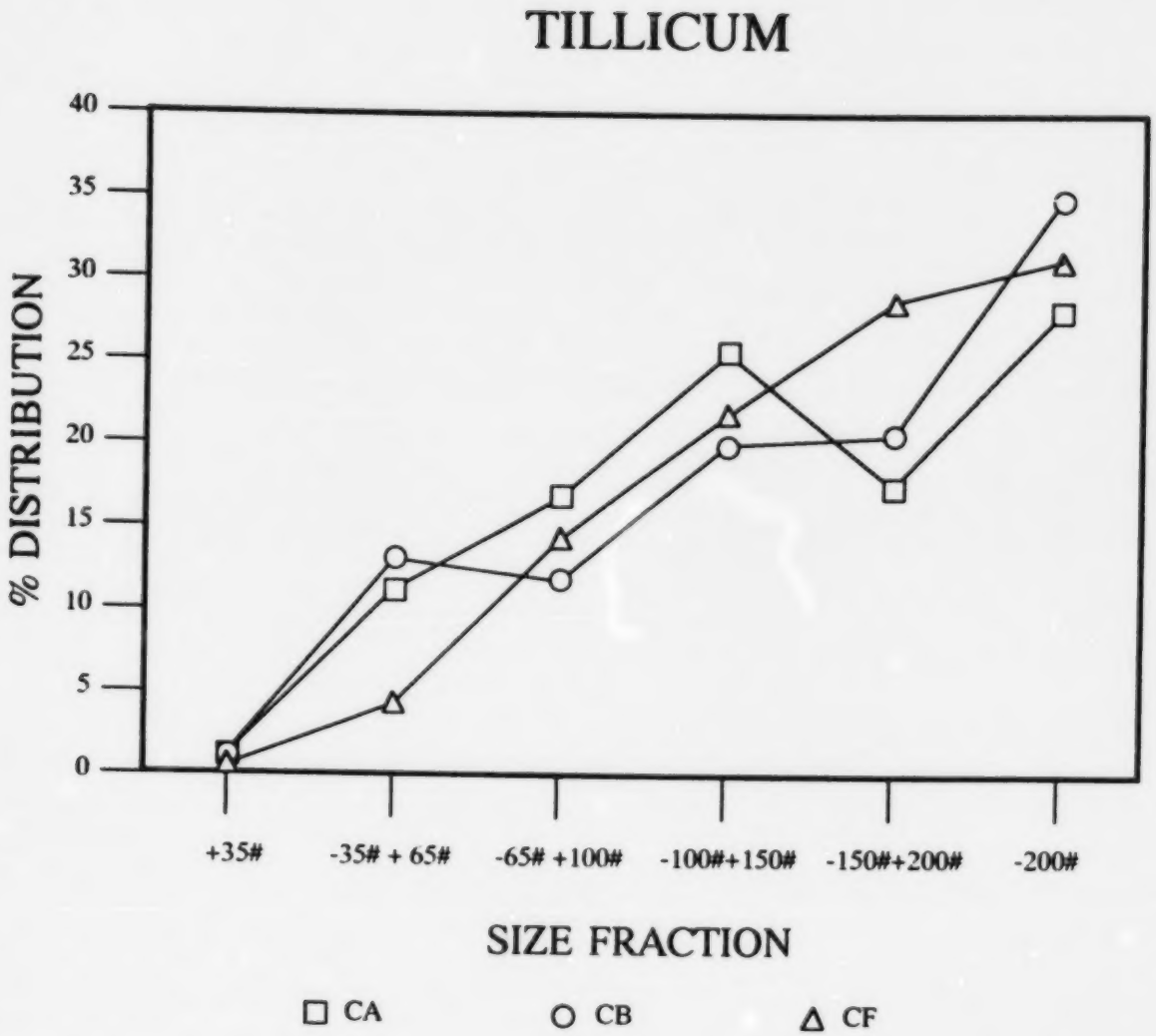
-200#
SIZE FRACTION
RUN #2
RUN #7
RUN #8

FIGURE 3.8


TILLICUM
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35
30
25
20
15
10
5
0
% DISTRIBUTION
+35#
-35# + 65#
-65# +100#
-100#+150#
-150#+200#
-200#
SIZE FRACTION
CA
CB
CF

FIGURE 3.9

In addition to the gold at the Ladner and Barnston sites being concentrated in different size fractions the gold also has different physical characteristics. Samples of concentrate from the two locations were superpanned to separate the gold flakes. Examples of gold from the two locations are shown in figures 3.10 and 3.11. It can be seen that the gold from the Ladner site is quite angular while the gold from the Barnston site consists of rounded, flattened flakes.

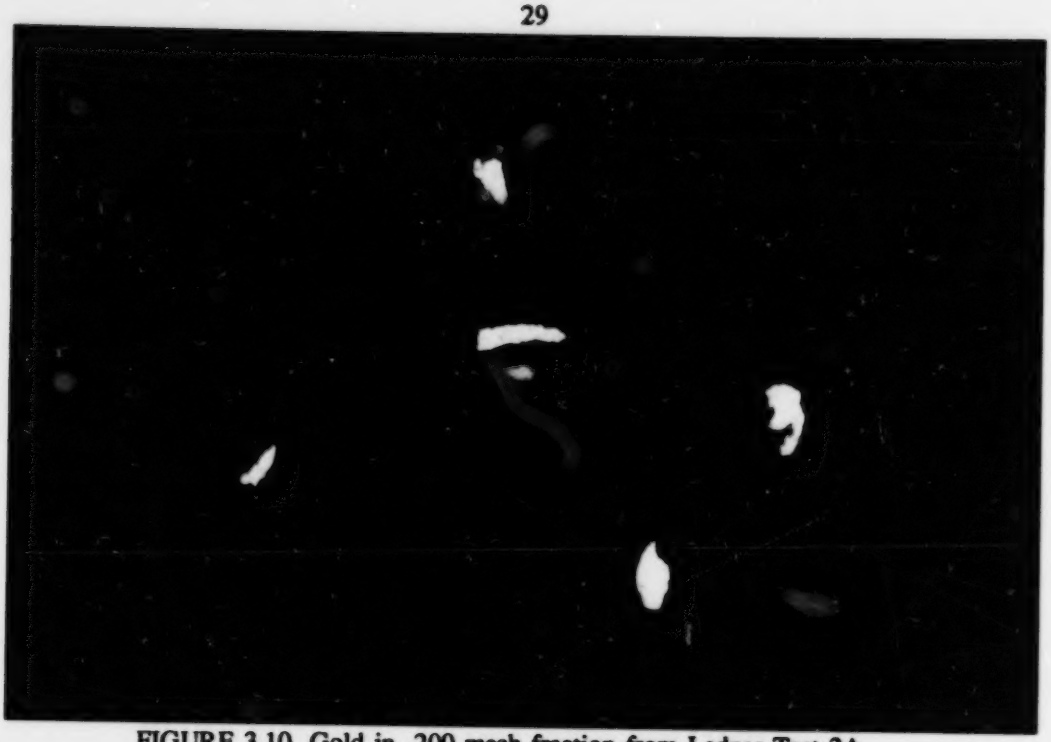

FIGURE 3.10 Gold in -200 mesh fraction from Ladner Test 2A.

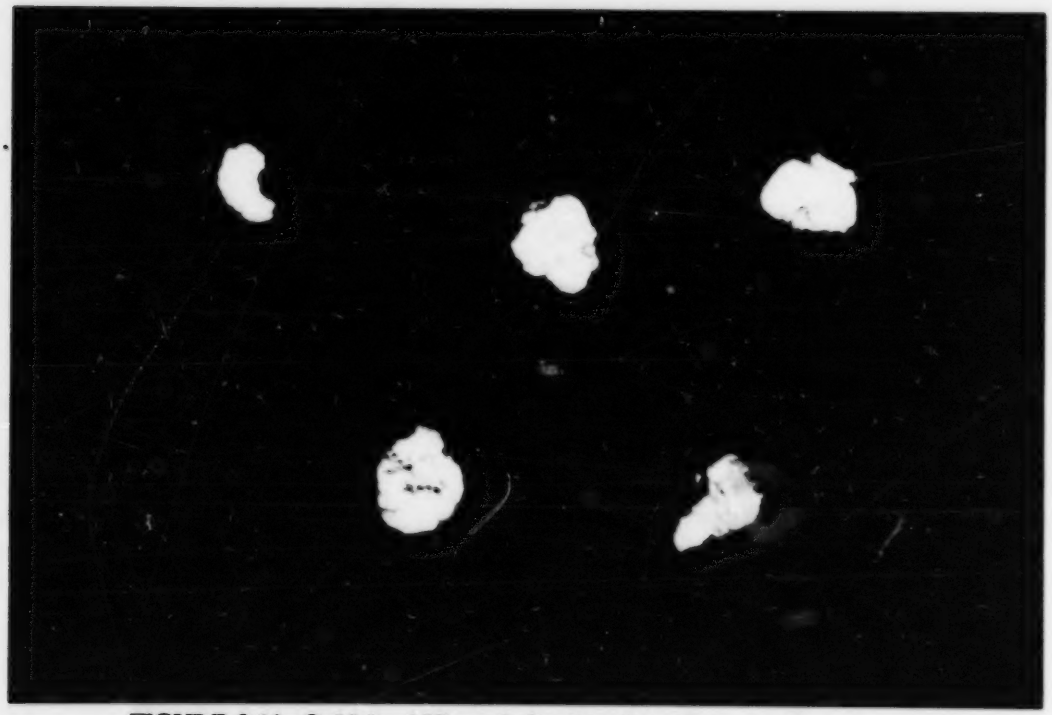

FIGURE 3.11 Gold in -100 mesh fraction from Barnston Test 1.

The analysis of the gold characteristics indicates that the centrifugal concentrator is capable of recovering gold across a wide size range and can recover gold having various shape factors.

SECTION 4
CONCLUSIONS

The methodology used in the present study was successful in removing a portion of the slurry from a dredge pipeline, treating this slurry and then re-introducing the tailings from the treatment into the pipe.

It was demonstrated in the study that fine particulate gold is present in the sands of the lower Fraser River and that at least a portion of this gold is recoverable by gravity concentration methods. The gold recovered at two locations on the Fraser occurred in different size fractions and demonstrated remarkably different shape factors. The concentration of gold which could be recoverable at these locations, even under optimum conditions, is uneconomic.

As the slurry from the dredge travels along the discharge line, some segregation of gold occurs towards the bottom of the pipe in spite of the turbulent flow conditions. This segregation permits a portion of the flow to be removed for treatment while leaving sufficient flow in the pipe to carry away the oversize material.

The data developed in the present study do not allow an accurate assessment of the overall metallurgical performance of the centrifugal concentrator. The concentration of gold in both the feed and tailings is so low that a comparison of these concentrations is essentially meaningless. The indication obtained from analyzing individual size fractions which contain the greatest proportion of the gold is that the centrifugal concentrator recovered less than 10% of the available gold.

SECTION 5
RECOMMENDATIONS

The present study has indicated that the concentration of gold in the lower Fraser River sands is not economically significant at the existing price for gold. Additional work to optimize the recovery of this gold is therefore not warranted.

The study has also indicated that while the technology developed by Canadian Gold Centrifuge Company does recover fine, particulate gold from a sand slurry, the metallurgical performance of the centrifuge needs to be better demonstrated. It is not certain whether the low gold recovery indicated in the present program is truly indicative of the capability of the device or whether it was a limitation imposed by the nature of the gold in the feed. Additional testwork is required to demonstrate that the concentrator can achieve acceptable metallurgical results in terms of both concentrate grade and recovery. These tests should be conducted with a feed material having free gold across a wide size range and should be done in such a way that a metallurgical balance can be prepared for each test.

APPENDIX I

Details of Size-Assays of Centrifuge Concentrates

Tests 1-9	Barnston site
Test 1A-5A	Ladner site
Test CA-CF	Tillicum site

TEST NUMBER: 7595 Run#1

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton ASSAYS	% DIST Au
+ 35#	395.1	40.44	0.002	0.61
- 35# + 65#	482.1	49.34	0.020	7.43
- 65# +100#	49.4	5.06	0.662	25.22
-100# +150#	19.6	2.01	2.367	35.77
-150# +200#	11.5	1.18	2.307	20.46
-200#	19.3	1.98	0.706	10.51
CALC HEAD	977.0	100.0	0.133	100.00

TEST NUMBER: 7595 Run#2

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton ASSAYS	% DIST Au
+ 35#	104.3	21.33	0.005	0.77
- 35# + 65#	268.8	54.98	0.079	31.21
- 65# +100#	24.4	4.99	0.779	27.93
-100# +150#	15.7	3.21	0.731	16.87
-150# +200#	17.5	3.58	0.451	11.60
-200#	58.2	11.90	0.136	11.63
CALC HEAD	488.9	100.0	0.139	100.00

TEST NUMBER: 7595 Run#3

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton ASSAYS	% DIST Au
+ 35#	52.8	10.82	0.003	0.20
- 35# + 65#	293.0	60.05	0.019	7.06
- 65# +100#	72.4	14.84	0.223	20.47
-100# +150#	27.1	5.55	1.051	36.11
-150# +200#	12.9	2.64	1.115	18.24
-200#	29.7	6.09	0.476	17.92
CALC HEAD	487.9	100.0	0.162	100.00

TEST NUMBER: 7595 Run#4

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton	ASSAYS	% DIST Au
+ 35#	316.3	32.36	0.001		0.76
- 35# + 65#	590.2	60.39	0.002		2.83
- 65# +100#	36.3	3.71	0.411		35.73
-100# +150#	12.0	1.23	1.232		35.40
-150# +200#	6.2	0.63	0.996		14.79
-200#	16.3	1.67	0.269		10.50
CALC HEAD	977.3	100.0	0.043		100.00

TEST NUMBER: 7595 Run#5

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton ASSAYS	% DIST Au
+ 35#	309.4	31.67	0.002	0.99
- 35# + 65#	599.7	61.39	0.002	1.92
- 65# +100#	23.3	2.39	1.077	40.14
-100# +150#	8.7	0.89	1.997	27.79
-150# +200#	7.2	0.74	1.397	16.09
-200#	28.6	2.93	0.286	13.06
CALC HEAD	976.9	100.0	0.064	100.00

TEST NUMBER: 7595 Run#6

PRODUCT	WEIGHT GMS	WEIGHT %	Au ASSAYS oz/ton	% DIST Au
+ 35#	395.8	40.52	0.002	2.41
- 35# + 65#	519.7	53.20	0.004	6.32
- 65# +100#	26.6	2.72	0.352	28.47
-100# +150#	11.0	1.13	0.858	28.70
-150# +200#	7.0	0.72	0.646	13.75
-200#	16.7	1.71	0.401	20.36
CALC HEAD	976.8	100.0	0.034	100.00

TEST NUMBER: 7595 Run#7

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton	ASSAYS	% DIST Au
+ 35#	184.0	37.64	0.003		0.29
- 35# + 65#	128.0	26.19	0.020		1.36
- 65# +100#	35.8	7.32	0.431		8.22
-100# +150#	26.0	5.32	1.332		18.46
-150# +200#	24.6	5.03	1.472		19.30
-200#	90.4	18.49	1.087		52.37
CALC HEAD	488.8	100.0	0.384		100.00

TEST NUMBER: 7595 Run#8

PRODUCT	WEIGHT GMS	WEIGHT %	Au ASSAYS oz/ton	% DIST Au
+ 35#	82.8	16.43	0.002	0.08
- 35# + 65#	131.2	26.03	0.004	0.26
- 65# +100#	22.8	4.52	0.995	11.41
-100# +150#	20.7	4.11	2.034	21.18
-150# +200#	31.0	6.15	1.143	17.83
-200#	215.5	42.76	0.454	49.23
CALC HEAD	504.0	100.0	0.394	100.00

TEST NUMBER: 7595 Run#9

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton	ASSAYS	% DIST Au
+ 35#	90.6	18.52	0.001		0.20
- 35# + 65#	319.7	65.36	0.008		5.66
- 65# +100#	15.5	3.17	0.775		26.58
-100# +150#	12.3	2.51	1.034		28.14
-150# +200#	13.7	2.80	0.473		14.34
-200#	37.3	7.63	0.304		25.09
CALC HEAD	489.1	100.0	0.092		100.00

TEST NUMBER: 7595 Run#1A CONC

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton ASSAYS	% DIST Au
+ 35#	192.2	38.44	0.002	0.52
- 35# + 65#	150.2	30.04	0.002	0.41
- 65# +100#	62.9	12.58	0.048	4.07
-100# +150#	36.6	7.32	0.234	11.55
-150# +200#	20.9	4.18	0.588	16.57
-200#	37.2	7.44	1.333	66.88
CALC HEAD	500.0	100.0	0.148	100.00

TEST NUMBER: 7595 Run#2A CONC

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton ASSAYS	% DIST Au
+ 35#	9.9	2.88	0.003	0.06
- 35# + 65#	76.9	22.39	0.001	0.15
- 65# +100#	137.4	40.01	0.003	0.81
-100# +150#	72.3	21.05	0.005	0.71
-150# +200#	26.5	7.72	0.003	0.16
-200#	20.4	5.94	2.435	98.10
CALC HEAD	343.4	100.0	0.147	100.00

TEST NUMBER: 7595 Run#3A CONC

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton	ASSAYS	% DIST Au
+ 35#	170.3	38.33	0.003		0.58
- 35# + 65#	141.6	31.87	0.002		0.32
- 65# +100#	53.8	12.11	0.078		4.77
-100# +150#	29.7	6.68	0.278		9.39
-150# +200#	16.2	3.65	0.986		18.16
-200#	32.7	7.36	1.796		66.78
CALC HEAD	444.3	100.0	0.198		100.00

TEST NUMBER: 7595 Run#4A CONC

PRODUCT	WLIGHT GMS	WEIGHT %	Au oz/ton	ASSAYS	% DIST Au
+ 35#	141.8	28.39	0.002		0.31
- 35# + 65#	193.4	38.73	0.001		0.21
- 65# +100#	66.2	13.26	0.021		1.51
-100# +150#	29.9	5.99	0.224		7.26
-150# +200#	18.9	3.78	1.081		22.14
-200#	49.2	9.85	1.286		68.57
CALC HEAD	499.4	100.0	0.185		100.00

TEST NUMBER: 7595 Run#5A CONC

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton	ASSAYS	% DIST Au
+ 35#	41.4	8.29	0.002		0.14
- 35# + 65#	58.9	11.80	0.002		0.20
- 65# +100#	107.0	21.43	0.021		3.83
-100# +150#	102.9	20.61	0.055		9.64
-150# +200#	78.4	15.71	0.177		23.64
-200#	110.6	22.16	0.332		62.55
CALC HEAD	499.2	100.0	0.118		100.00

TEST NUMBER: 7595 CA

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton ASSAYS	% DIST Au
+ 35#	457.4	62.66	0.001	0.65
- 35# + 65#	68.3	9.36	0.117	11.40
- 65# +100#	25.6	3.51	0.455	16.62
-100# +150#	32.3	4.42	0.556	25.61
-150# +200#	41.2	5.64	0.301	17.66
-200#	105.2	14.41	0.187	28.05
CALC HEAD	730.0	100.0	0.096	100.00

TEST NUMBER: 7595 CB

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton ASSAYS	% DIST Au
+ 35#	436.5	49.99	0.001	0.51
- 35# + 65#	162.6	18.62	0.068	12.80
- 65# +100#	55.8	6.39	0.171	11.05
-100# +150#	58.1	6.65	0.300	20.17
-150# +200#	53.3	6.11	0.335	20.68
-200#	106.9	12.24	0.281	34.78
CALC HEAD	873.2	100.0	0.099	100.00

TEST NUMBER: 7595 CF

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton	ASSAYS	% DIST Au
+ 35#	245.3	43.34	0.001		0.10
- 35# + 65#	101.0	17.84	0.115		4.70
- 65# +100#	37.8	6.68	0.897		13.73
-100# +150#	36.4	6.42	1.453		21.37
-150# +200#	37.7	6.65	1.869		28.46
-200#	107.9	19.06	0.725		31.65
CALC HEAD	566.0	100.0	0.437		100.00

APPENDIX II

Size-Assays of Centrifuge Tailings at Ladner Site

TEST NUMBER: 7595 Run#1A TAILS

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton	ASSAYS	% DIST Au
+ 35#	60.3	14.33	0.004		20.09
- 35# + 65#	136.4	32.41	0.003		34.09
- 65# +100#	114.6	27.23	0.002		19.10
-100# +150#	60.1	14.28	0.002		10.01
-150# +200#	29.2	6.94	0.002		4.87
-200#	20.3	4.82	0.007		11.84
CALC HEAD	420.9	100.0	0.003		100.00

TEST NUMBER: 7595 Run#2A TAILS

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton	ASSAYS	% DIST Au
+ 35#	53.7	13.20	0.002		13.97
- 35# + 65#	158.8	39.05	0.002		41.31
- 65# +100#	124.3	30.56	0.001		16.17
-100# +150#	48.2	11.85	0.001		6.27
-150# +200#	13.7	3.37	0.002		3.56
-200#	8.0	1.97	0.018		18.73
CALC HEAD	406.7	100.0	0.002		100.00

TEST NUMBER: 7595 Run#3A TAILS

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton ASSAYS	% DIST Au
+ 35#	40.4	8.06	0.002	7.20
- 35# + 65#	168.0	33.53	0.002	29.95
- 65# +100#	177.3	35.38	0.001	15.81
-100# +150#	81.5	16.26	0.001	7.27
-150# +200#	25.2	5.03	0.007	15.73
-200#	8.7	1.74	0.031	24.04
CALC HEAD	501.1	100.0	0.002	100.00

TEST NUMBER: 7595 Run#4A TAILS

PRODUCT	WEIGHT GMS	WEIGHT %	Au oz/ton	ASSAYS	% DIST Au
+ 35#	15.8	3.16	0.004		8.67
- 35# + 65#	118.9	23.81	0.002		32.61
- 65# +100#	207.2	41.50	0.001		28.41
-100# +150#	103.2	20.67	0.001		14.15
-150# +200#	38.3	7.67	0.001		5.25
-200#	15.9	3.18	0.005		10.90
CALC HEAD	499.3	100.0	0.001		100.00